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(54) Interface between a mobile radio device and its accessory device based on capacitive coupling for sharing ground planes to rise antenna gain of accessory device

(57) The present invention provides an arrangement or interface (131) for capacitively coupling the ground plane (230) of a mobile device (200) with the ground plane (130,131) of its accessory device (100). Thus, the ground planes of both devices are shared. This results in an extended ground plane (130,131,230)

of the accessory device (100) for rising the antenna gain of a patch antenna (120) incorporated in its housing (110). Hence, the accessory device can be further miniaturized without the drawback of lower antenna gain. The mobile device (200) can be a mobile telephone terminal, its accessory device can be a mobile positioning terminal.

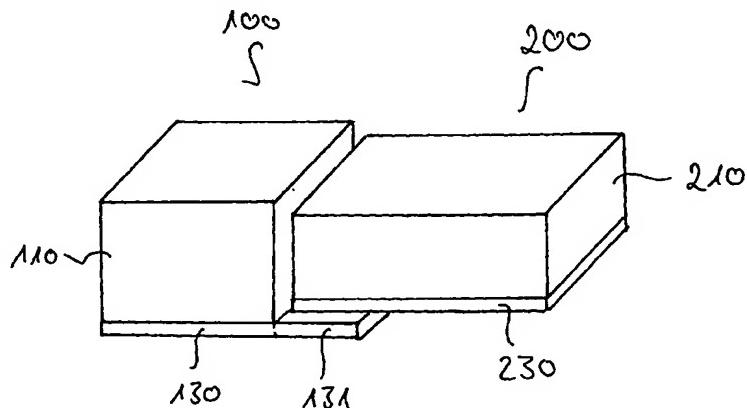


Fig 2

**Description****FIELD OF THE INVENTION**

**[0001]** The present invention relates to a first device having a first housing, an antenna system and a first area of ground potential, connectable to a second device having a second housing and a second area of ground potential. The present invention further relates to an arrangement for receiving or transmitting radio signals, where a first device is connected to a second device and particularly where an accessory device is connected to a mobile device.

**DESCRIPTION OF THE PRIOR ART**

**[0002]** In current mobile devices, like e.g. a mobile telephone or personal organizer the size or dimension of such a mobile device tends to be smaller and smaller. Concurrently it is required to add more and more additional functionality like e.g. for positioning or a chatboard or a MP3 player to the base functionality.

**[0003]** Due to the minimized dimensions of the mobile device additional functionality can be added to a mobile telephone system either by developing a new mobile device which includes both the telephone and additional functionality or by mounting a separate accessory device with additional functionality to an already existing mobile device. Such an accessory device permits a higher flexibility for a user, because additional functionality can be added or removed whenever wanted. Therefore e.g. a MP3 player device can be mounted to the mobile telephone device, where an existing system connector of that mobile telephone device operates for mechanical mounting the two devices as well as for electrical connecting the two devices to share electrical resources like battery, display etc.

**[0004]** In other cases, e.g. in the United States it is considered necessary to use a positioning device at any time. Therefore such an accessory device has to be permanently plugged to the mobile device. Hence such an accessory device should have dimensions as small as possible to achieve the overall smallest size of that mounted arrangement.

**[0005]** A positioning device in general consists of electrical components like e.g. a patch antenna and a related ground potential. An acceptable high reception performance of the antenna requires a minimum size of the area of ground potential. The greater the area of the ground potential, the higher the reception performance of the antenna, e.g. the antenna gain. Therefore the size of the area of ground potential should be as great as possible. But this is a condition, which is in sharp conflict with the dimensions a user wants to have for such a mobile device.

**[0006]** Consequently, a need exists for a device and an arrangement of such devices, which has minimized dimensions and a high reception performance.

**SUMMARY OF THE INVENTION**

- [0007]** It is therefore a principal object of the present invention to provide a first device, which is connectable to a second device and where a first area of ground potential has a coupling area, which is formed in respect to the shape of a second area of ground potential, and where said coupling area covers at least a part of said second area of ground potential, when said first device is connected to said second device, and where said second area of ground potential is capacitive coupled to said first area of ground potential, when said coupling area covers at least a part of said second area of ground potential.
- [0008]** Preferably such a device can be made as small as the including electrical components allows it, but ignoring the size of the area of ground potential, which will be necessary to maintain a certain reception performance. Since the coupling area allows capacitive coupling of additional area of ground potential, the dimension of such a device can be independent of the necessary area of ground potential.
- [0009]** It is still further an object of the present invention to provide a first device where the coupling area of the first area of ground potential is protruding beyond the housing of that first device.
- [0010]** Therefore the coupling part allows easy covering of the area of ground potential from a second device. Further when the coupling area which is protruding beyond the housing is formed in respect to the shape of a part of the housing of that second device, a mechanical fixation of that first device to that second device can be achieved.
- [0011]** Further it is still a principal object of the present invention to provide an arrangement with a first and a second device according to claim 8.
- [0012]** It is an advantage of the present invention, that in such an arrangement the area of ground potential of the second device is shared by both devices, especially when the dimension of that first device is too small to allow a size of area of ground potential, which is necessary to maintain a certain reception performance.
- [0013]** The invention is therefore preferably provided for an arrangement where, according to claim 11 or 12, an accessory device like e.g. a positioning terminal is coupled to a mobile device like e.g. an already existing mobile telephone terminal.
- [0014]** There a need exists that the total size of such an arrangement has to be as small as possible, the additional positioning device has to be as small as possible, too. Thus the present invention allows that the dimensions of that positioning system is not determined by the needed area of ground potential to achieve a good antenna performance. Rather the necessary dimension of area of ground potential can be achieved by coupling additional area of ground potential from the existing standard mobile telephone terminal to the positioning terminal.

[0015] The present invention in general has the advantage that especially when a new small accessory device is created for an already existing mobile device, there are no changes necessary to the mobile device to couple additional area of ground potential from that mobile device to the accessory device. In particular, when a part of the housing of that mobile device, e.g. the bottom of that housing, is the area of ground potential and therefore is made out of metal or laminated with a metal foil, it is only necessary to create the coupling area of that accessory device in respect to that mobile device to achieve a capacitive coupling, when both devices are connected. Thus a coupling of area of ground potential requires connectors with thick contact pins, which would lead to necessary changes of the system connector in both devices, here it is an advantage that the invention permits that no additional or special dimensioned connector in the housing of that mobile device is necessary to combine the areas of ground potential nor any other change on the existing mobile device.

#### BRIEF DESCRIPTION OF THE INVENTION

[0016] The present invention will be better understood by reading the following description of the preferred embodiment of the invention and in conjunction with the appended drawings wherein:

Fig.1 is a schematic representation of a positioning device according to a preferred embodiment.

Fig.2 is a schematic representation of a preferred arrangement with a positioning device and a mobile telephone device.

[0017] In Fig.1 a positioning device 100 for receiving Global Positioning System (GPS) signals is shown. To receive signals, which are transmitted by GPS satellites a patch antenna 120 is included in a housing 110. To obtain a good antenna performance an area of ground potential 130 is used as reference for that antenna 120. Due to the fact that such an accessory device has to be as small as possible the smallest dimensions of the housing 110 are given by the included electrical components. Here there are mainly the antenna 120 and an ASIC, which is not shown. But thus the available space for an area of ground potential is limited. In this embodiment the area of ground potential is a part of the housing which form the bottom of the housing and the coupling area 131 is protruding beyond that housing 110. Therefore that part of the area of ground potential can be used as a coupling area 131, which allows a capacitive coupling of additional area of ground potential from outside of the housing 110.

[0018] The effect of capacitive coupling of two mounted devices will now be explained in more detail exemplary with Fig.2, where the combination of such an accessory device and a mobile telephone device is illus-

trated. Here again an accessory device 100, like a GPS receiver with a housing 110 and at least an antenna 120 and an area of ground potential 130 with a coupling area 131 is shown. That positioning device 100 is connected with a mobile telephone device 200. The mobile telephone device 200 is an already existing mobile phone, which has a housing 210 and a area of ground potential 230 and which has all functionality to establish a telephone call and all necessary user interfaces, like a display, keys, etc., but which are not shown here.

[0019] The two devices 100 and 200 are connected, e.g. by clipping the housing 110 to the housing 210 and an already existing system connector, which is not shown, of that mobile telephone device. The system connector allows that e.g. the user interfaces can be shared by both devices, e.g. the positioning data calculated by the mobile positioning device 100 are provided to the user via the display of that mobile telephone system. Therefore electrical signals are transferred via that system connector and a matching system connector in that mobile positioning device 100. Such a typical system connector has multiple thin pins for transferring the signals and the related signal ground, which of course can be identical to ground potential of the area of ground potential. Additional it could be possible to connect the area of ground potential from that accessory device and that mobile telephone device via that system connector, but that leads to the disadvantage that due to the thin pins the connection is not usable for connecting area of ground potential. Alternatively usage of thick pins or a lot of pins for ground connection this would be a feasible solution, but this requirements are completely contrary to the requirements that a mobile and accessory device have to be as small as possible.

[0020] When connecting the accessory device and the mobile telephone device together the coupling area 131, which is protruding beyond the housing 110, covers a part of the area of ground potential 230 of that mobile telephone device 200. In the preferred embodiment the coupling area has dimensions of around 12 by 45 mm and the airgap is around 0.1mm. Therefore a coupling between the area of ground potential of the accessory device and the mobile device with a capacitive of 47pF is achieved.

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#### Claims

1. A first device (100) having a first housing (110), an antenna system (120) and a first area of ground potential (130), wherein said first device (100) is connectable to a second device (200) having a second housing (210) and a second area of ground potential (230)
- 50
- characterized in that**
- said first area of ground potential (130) has a coupling area (131), which is formed in respect

- to the shape of said second area of ground potential (230),
- said coupling area (131) covers at least a part of said second area of ground potential (230), when said first device (100) is connected to said second device (200),
  - and where said second area of ground potential (230) is capacitive coupled to said first area of ground potential (130), when said coupling area (131) covers at least a part of said second area of ground potential (230). 10
2. The first device according to claim 1, **characterized in that** at least a part of the first housing (110) of said first device (100) is the first area of ground potential (130). 15
3. The first device according to claim 1 or 2, **characterized in that** said coupling area (131) of said first area of ground potential (130) protrude beyond the housing. 20
4. The first device according to claim 1-3, **characterized in that** the antenna system (120) is a patch antenna. 25
5. The first device according to claim 4, **characterized in that** said first device is a mobile positioning terminal. 30
6. The first device according to claim 1-3, **characterized in that** the antenna system (120) is a planar inverted F antenna. 35
7. The first device according to claim 6, **characterized in that** said first device is a mobile telephone terminal.
8. An arrangement for receiving or transmitting radio signals, where a first device (100) having a first housing (110) and an antenna system (120) and a first area of ground potential (130), is connected to a second device (200), having a second housing (210) and a second area of ground potential (230), **characterized in that** 40
- said first area of ground potential (130) has a coupling area (131) which is formed in respect to the shape of said second area of ground potential(230),
  - said coupling area (131) covers at least a part of said second area of ground potential (230),
  - and where said second area of ground potential (230) is capacitive coupled to said first area of ground potential (130), when said coupling area (131) covers at least a part of said second area of ground potential (230). 45
9. The arrangement according to claim 8, **characterized in that** at least a part of the second housing (210) is the second area of ground potential (230). 50
10. The arrangement according to claim 8 or 9, **characterized in that** at least a part of said first housing (110) is the first area of ground potential (130). 55
11. The arrangement according to claim 8 to 10, **characterized in that** said second device (200) is a mobile device and said first device (100) is an accessory device for said mobile device.
12. The arrangement according to claim 11, **characterized in that** said mobile device is a mobile telephone terminal and said accessory device is a mobile positioning terminal.

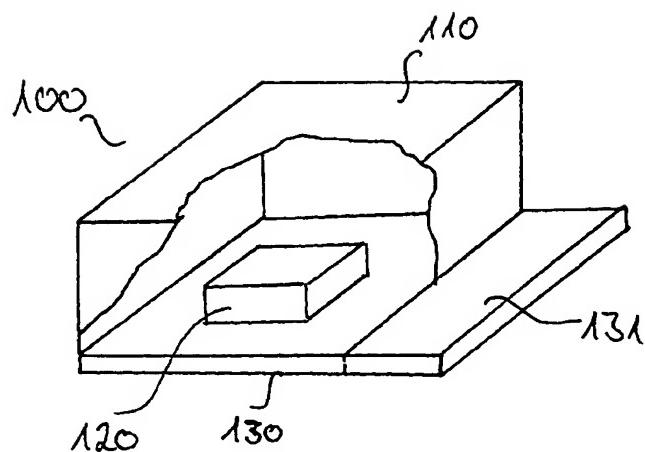


Fig 1

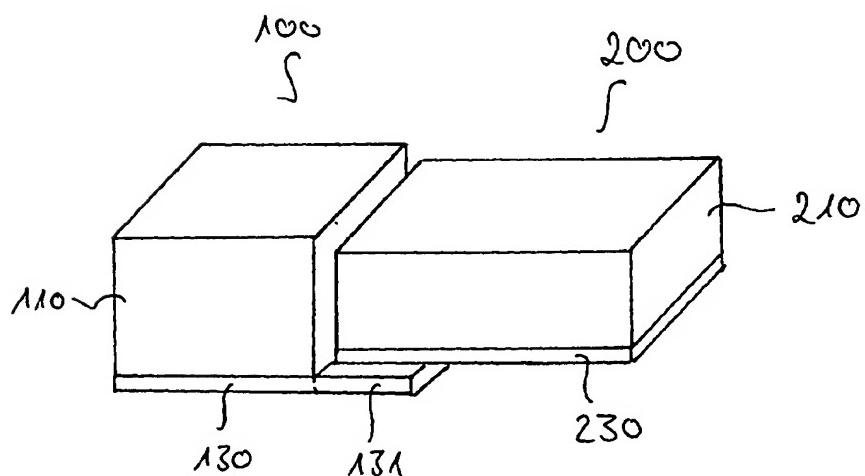


Fig 2



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## EUROPEAN SEARCH REPORT

Application Number  
EP 01 11 1601

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.)
X	US 6 215 447 B1 (JOHNSON GREG) 10 April 2001 (2001-04-10) * column 1, line 33-36 * * column 2, line 10-41 * * column 3, line 66 - column 4, line 63; figures 4B,5 *	1-11	H01Q9/04 H01Q1/24
Y	* column 5, line 22-33 *	12	
Y	US 5 949 369 A (BRADLEY JAMES FREDERICK ET AL) 7 September 1999 (1999-09-07) * column 6, line 45 - column 7, line 33; figures 7,8A,8B,8C,9A *	12	
A	WO 99 54956 A (ALLGON AB ;KURZ HANS PETER (SE); JOHNSON HOWARD WILLIAM (US)) 28 October 1999 (1999-10-28) * page 6, line 9-26; figure 1 * * page 9, line 20 *	1-12	
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A	US 6 160 515 A (MCCOY DANNY O ET AL) 12 December 2000 (2000-12-12) * abstract *	1-11	
<p>The present search report has been drawn up for all claims</p>			
Place of search	Date of completion of the search	Examiner	
MUNICH	23 January 2002	Schmelz, C	
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : Intermediate document			

**ANNEX TO THE EUROPEAN SEARCH REPORT  
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EP 01 11 1601

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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